

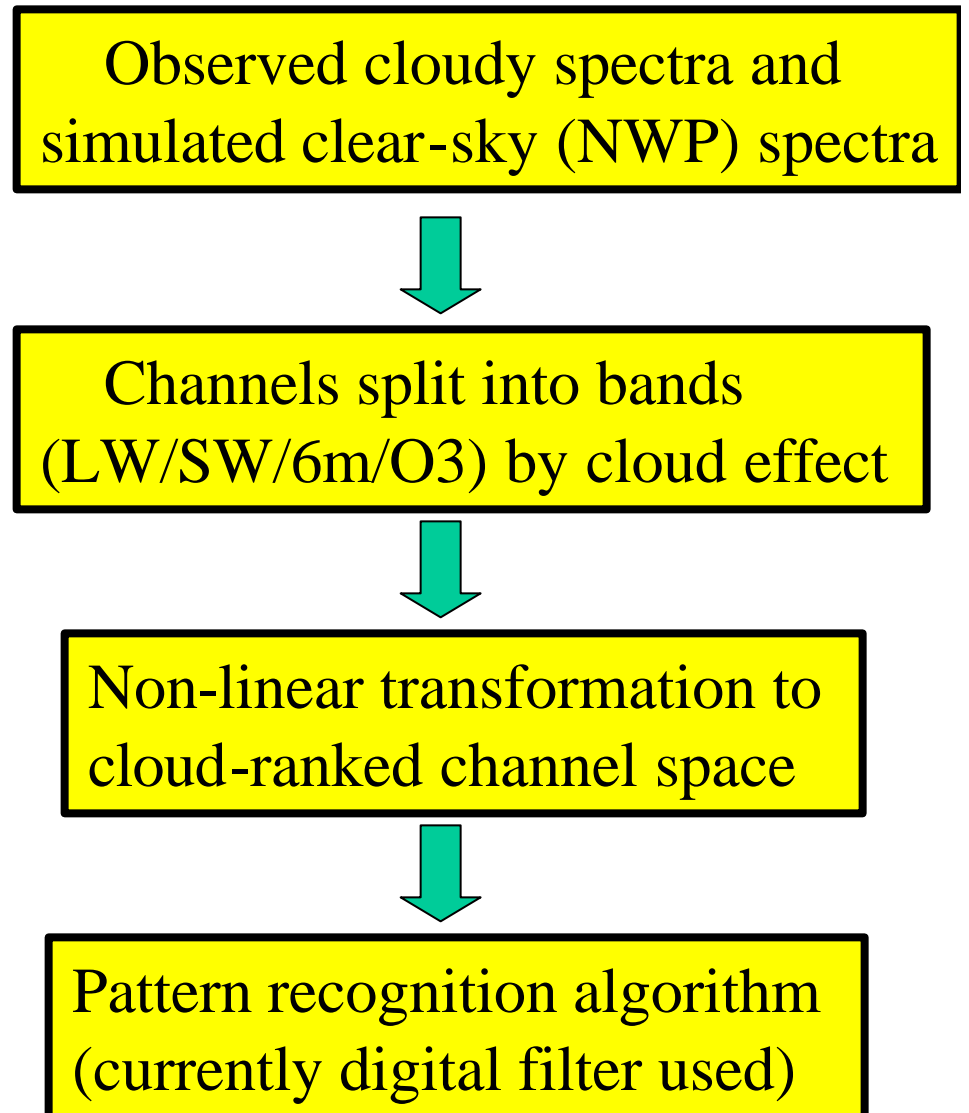
ECMWF analysis of the AIRS focus-day 20 July 2002

Tony McNally / Phil Watts / Marco Matricardi

- Introduction
- Detection of clear channels
- Clear-sky departure statistics
- preliminary 3DVAR assimilation results
- status and plans

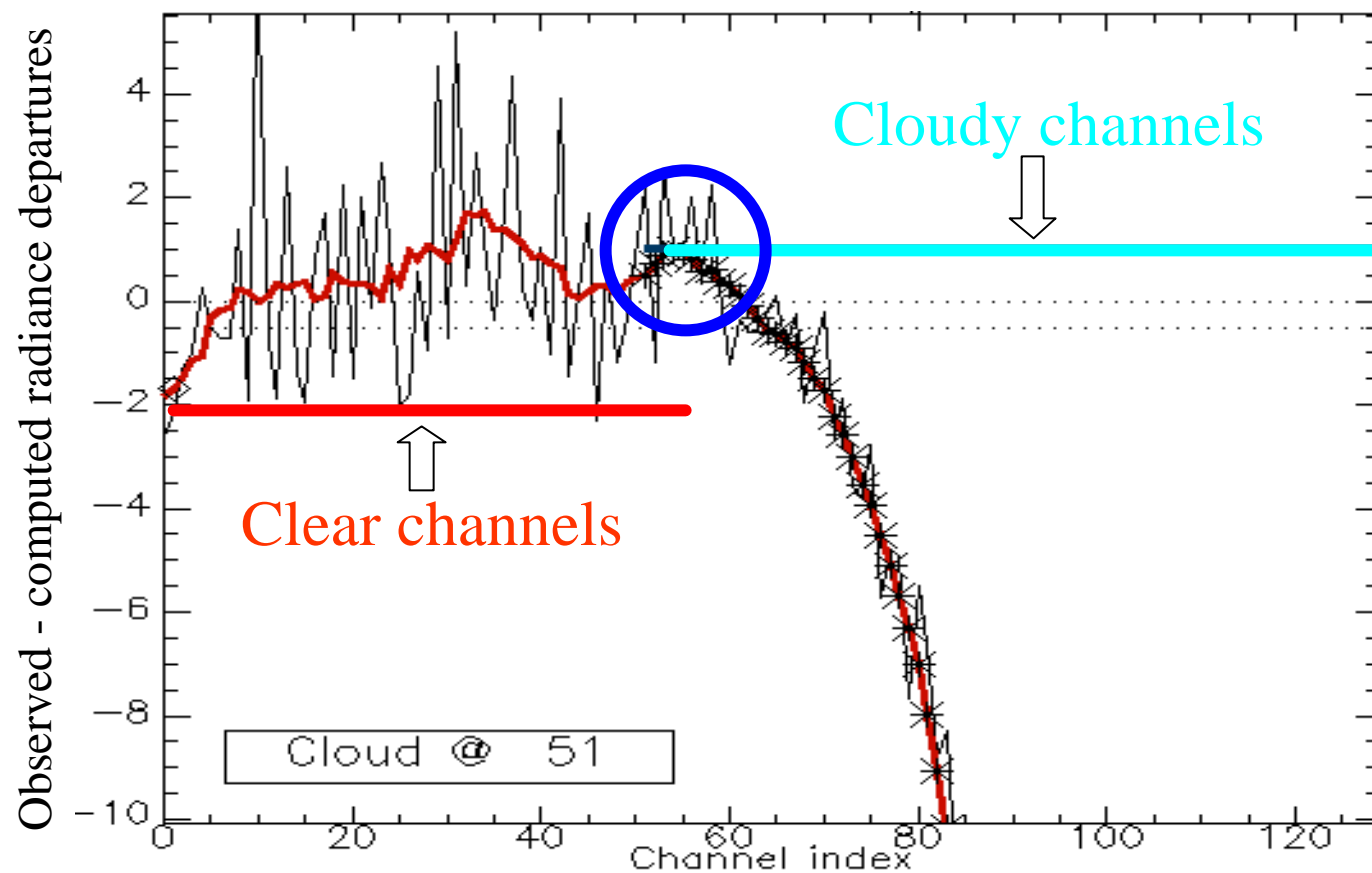
ECMWF cloud detection algorithm for AIRS

- Exploits NWP model accuracy (particularly in mid-upper trop constrained by AMSUA)
- Aims at dynamically finding **clear channels** rather than completely clear locations
- So far validated with simulated cloudy AIRS radiances
- Extendable to CrIS / IASI



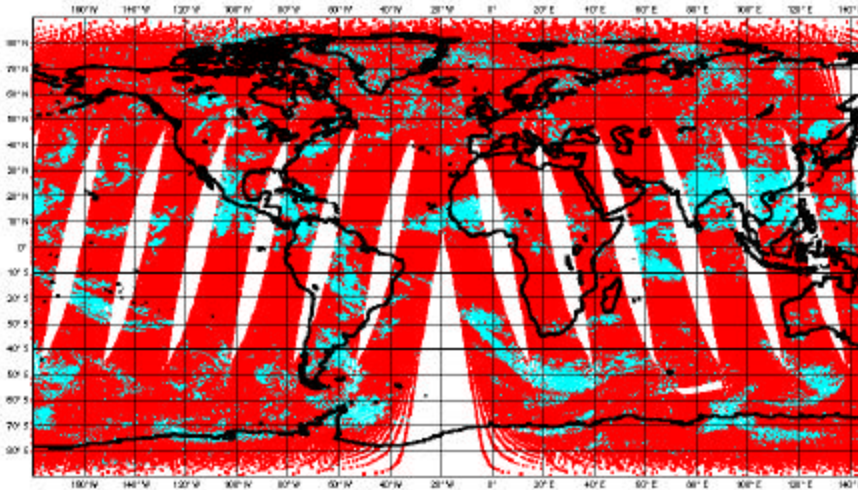
ECMWF cloud detection scheme

(example for LW band from AIRS focus day)

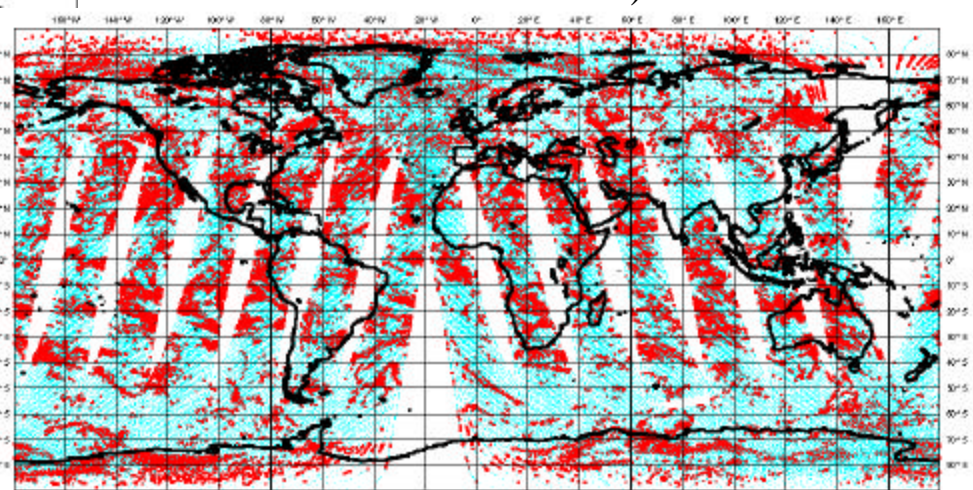


Distribution of data flagged clear

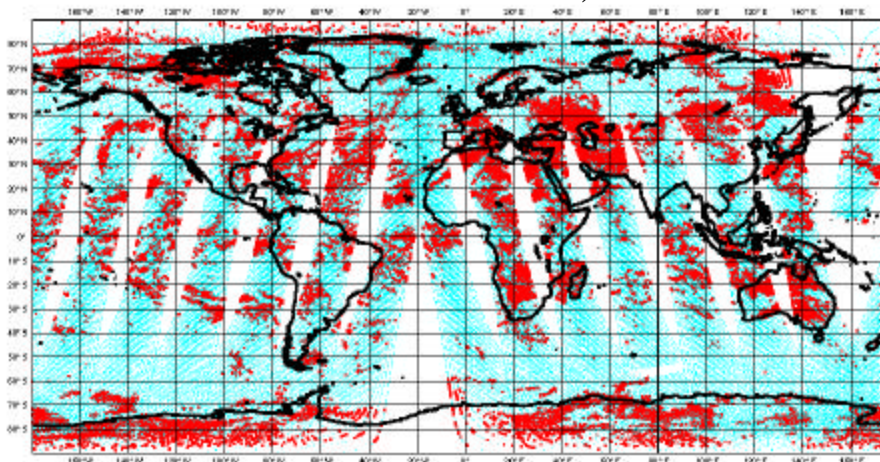
AIRS channel **145** (14.5micron similar to HIRS channel 3 100hPa)



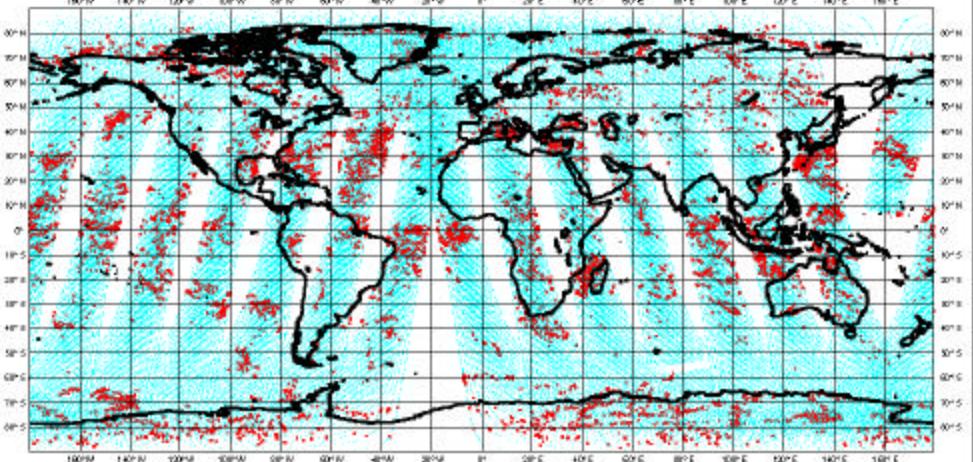
AIRS channel **1694** (6.7micron similar to HIRS channel 12 400hPa)



AIRS channel **226** (13.5micron similar to HIRS channel 5 600hPa)

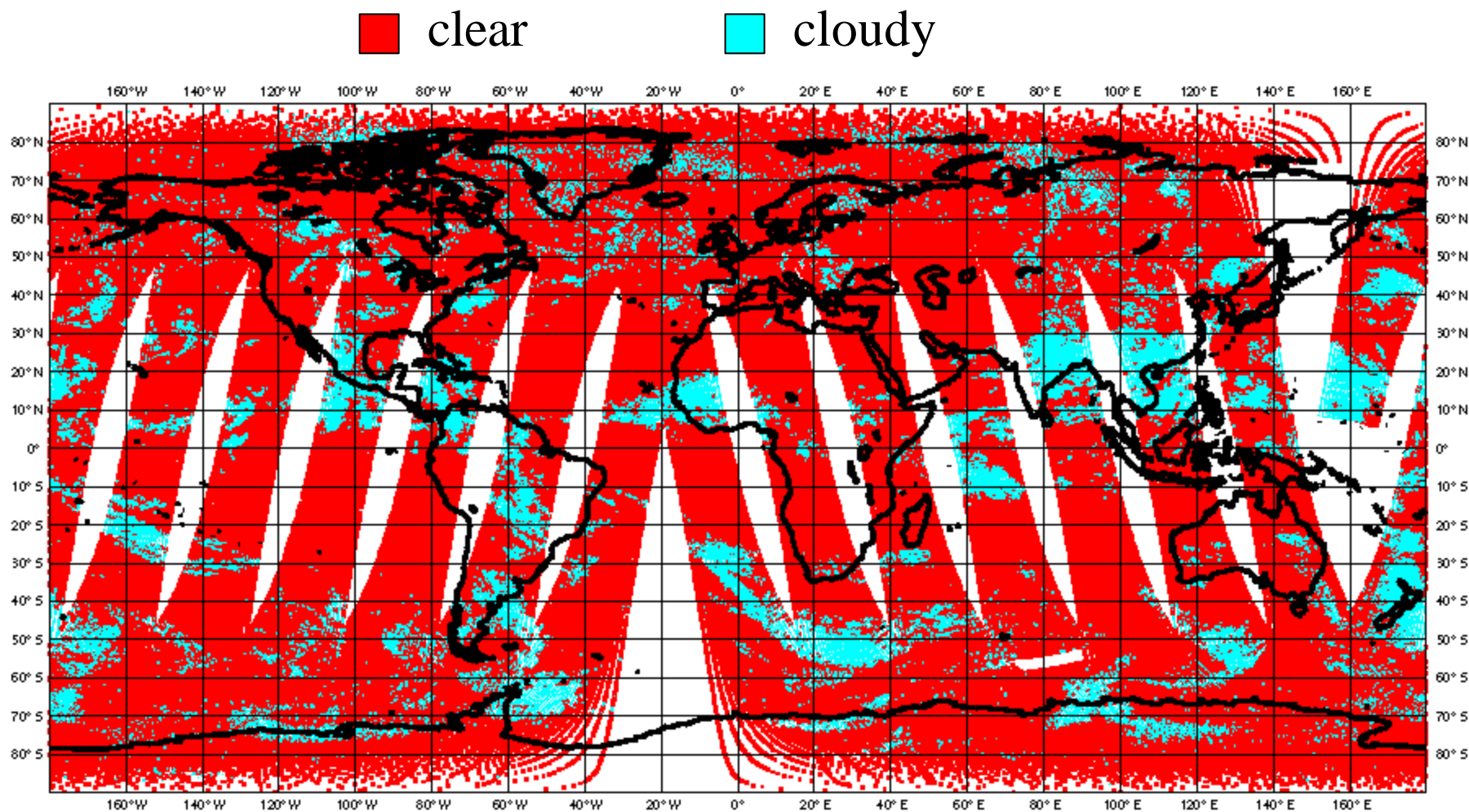


AIRS channel **787** (11 micron similar to HIRS channel 8 window)



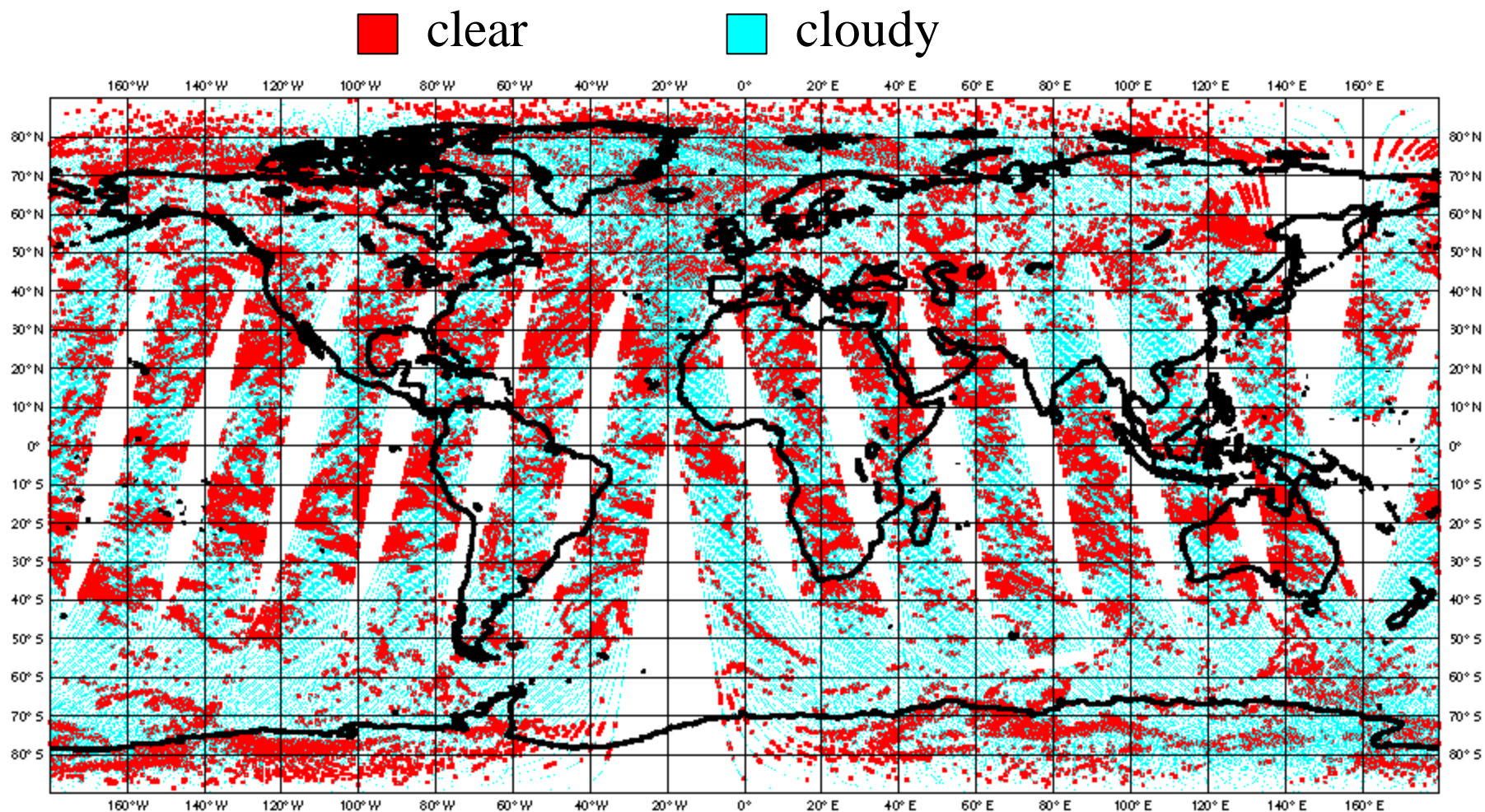
ECMWF detection of clear channels

AIRS channel **145** (*14.5micron similar to HIRS channel 3 100hPa*)



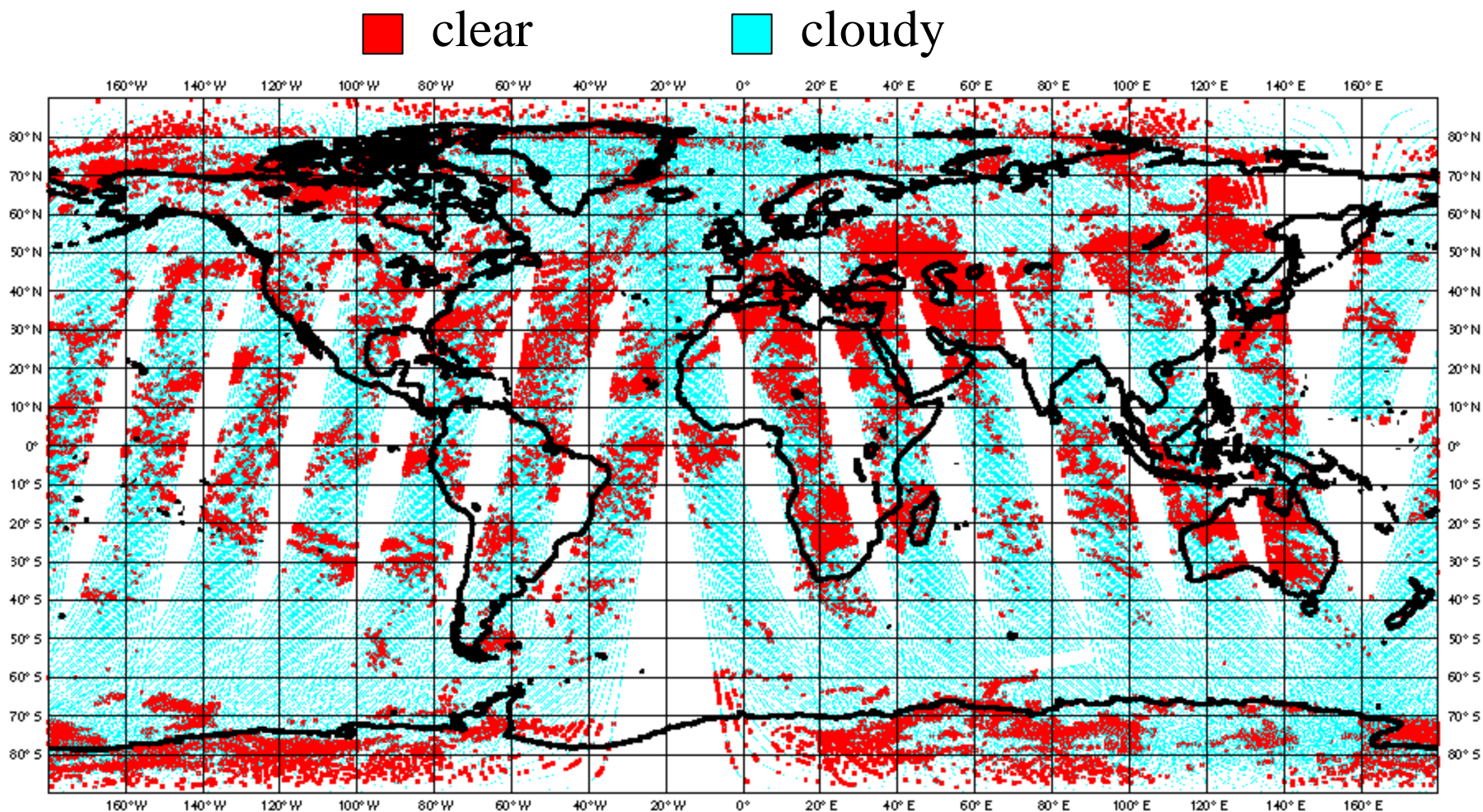
ECMWF detection of clear channels

AIRS channel **1694** (*6.7micron similar to HIRS channel 12 UTH*)



ECMWF detection of clear channels

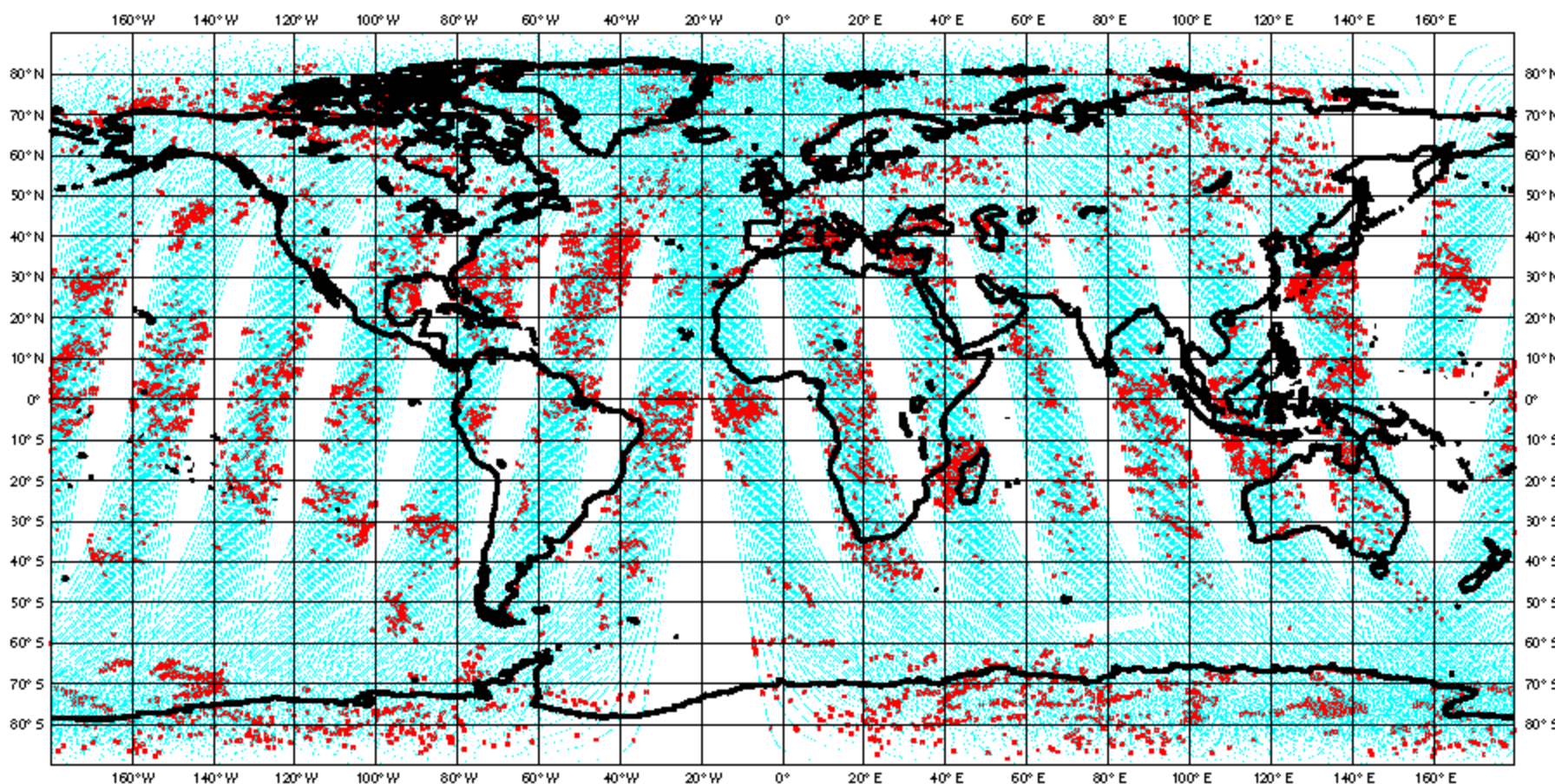
AIRS channel **226** (*14.0micron similar to HIRS channel 5 600hPa*)



ECMWF detection of clear channels

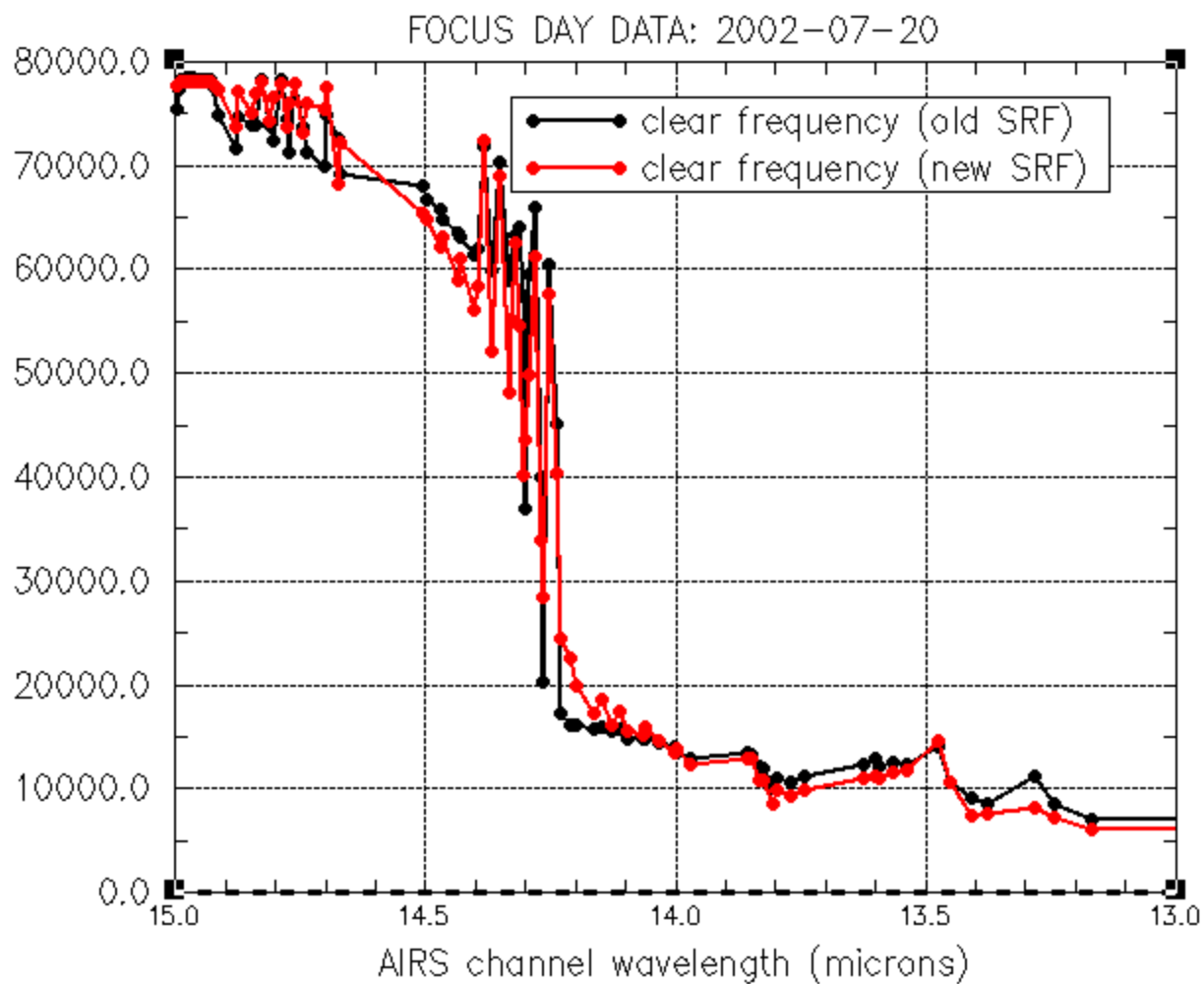
AIRS channel **787** (*11micron similar to HIRS channel 8 window*)

■ clear ■ cloudy



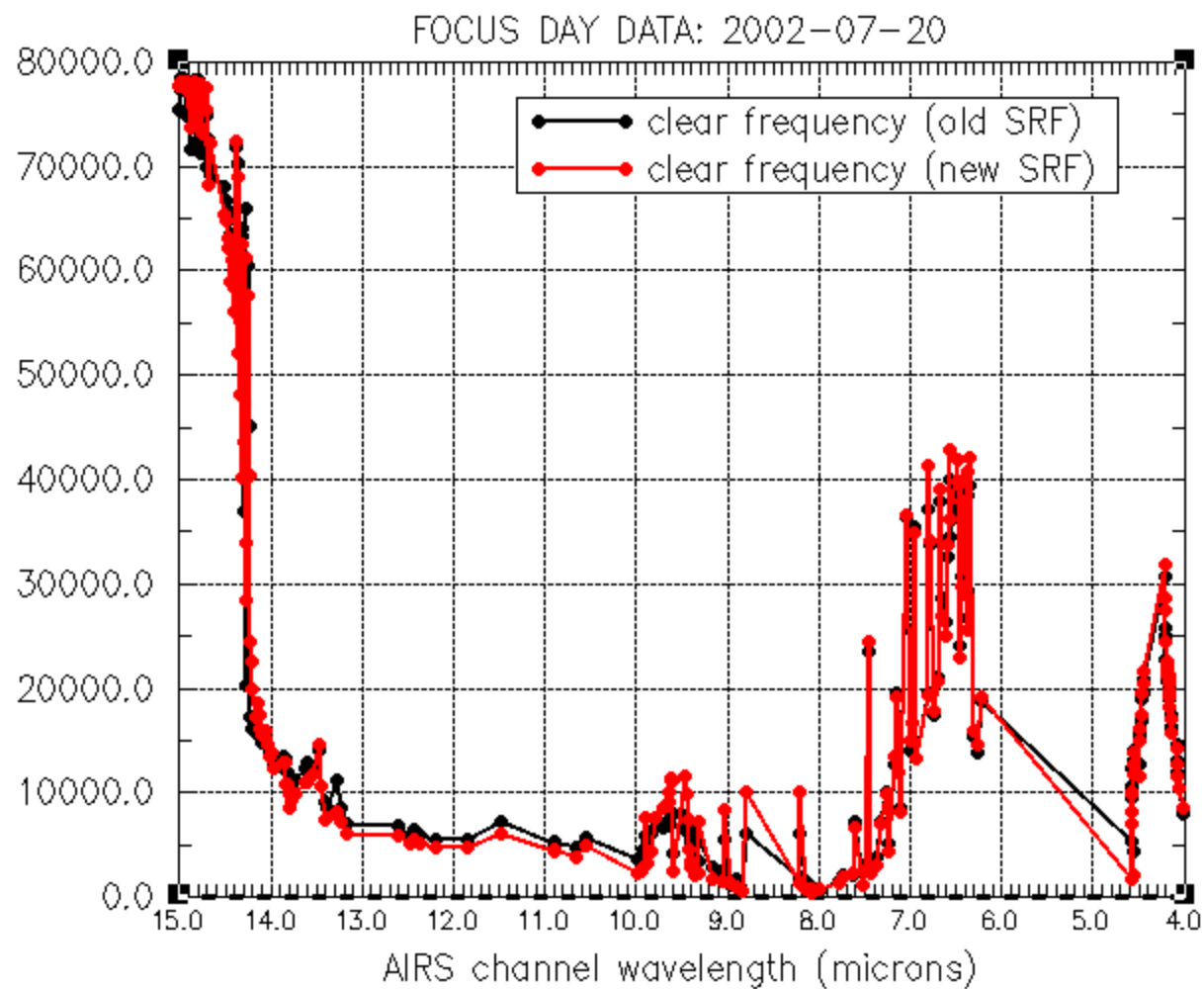
Frequency of AIRS channels flagged CLEAR

(Longwave Band only)



Frequency of AIRS channels flagged CLEAR

(Whole AIRS spectrum)



AIRS clear-sky radiance departures from the ECMWF model

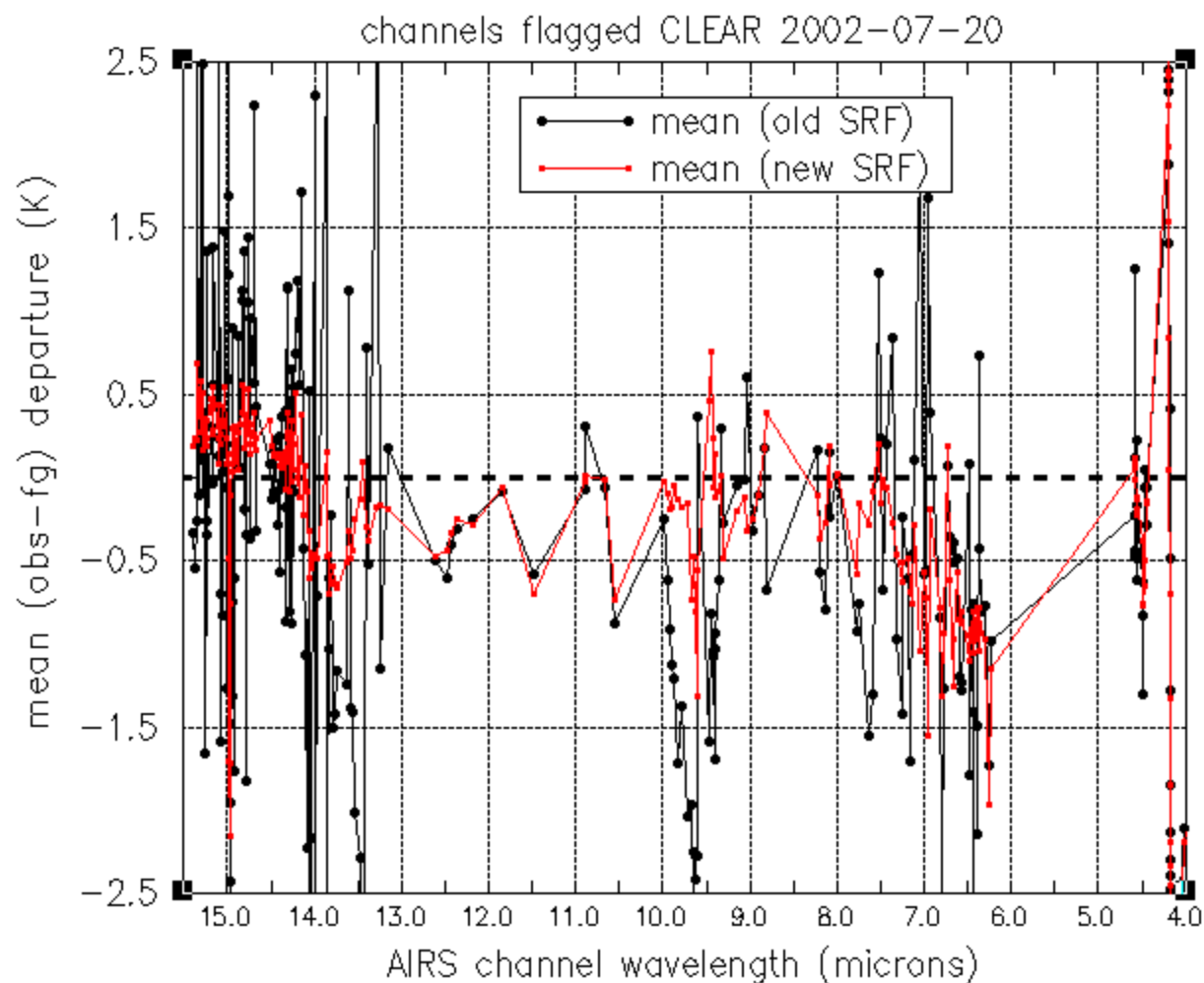
The ECMWF model fields (T/Q/O3) are interpolated to the AIRS locations and are valid to within 1 hour of the observation time.

Clear-sky radiances for each AIRS channel are then computed using the RTTOV radiative transfer model using SRFs supplied by L.Strow.

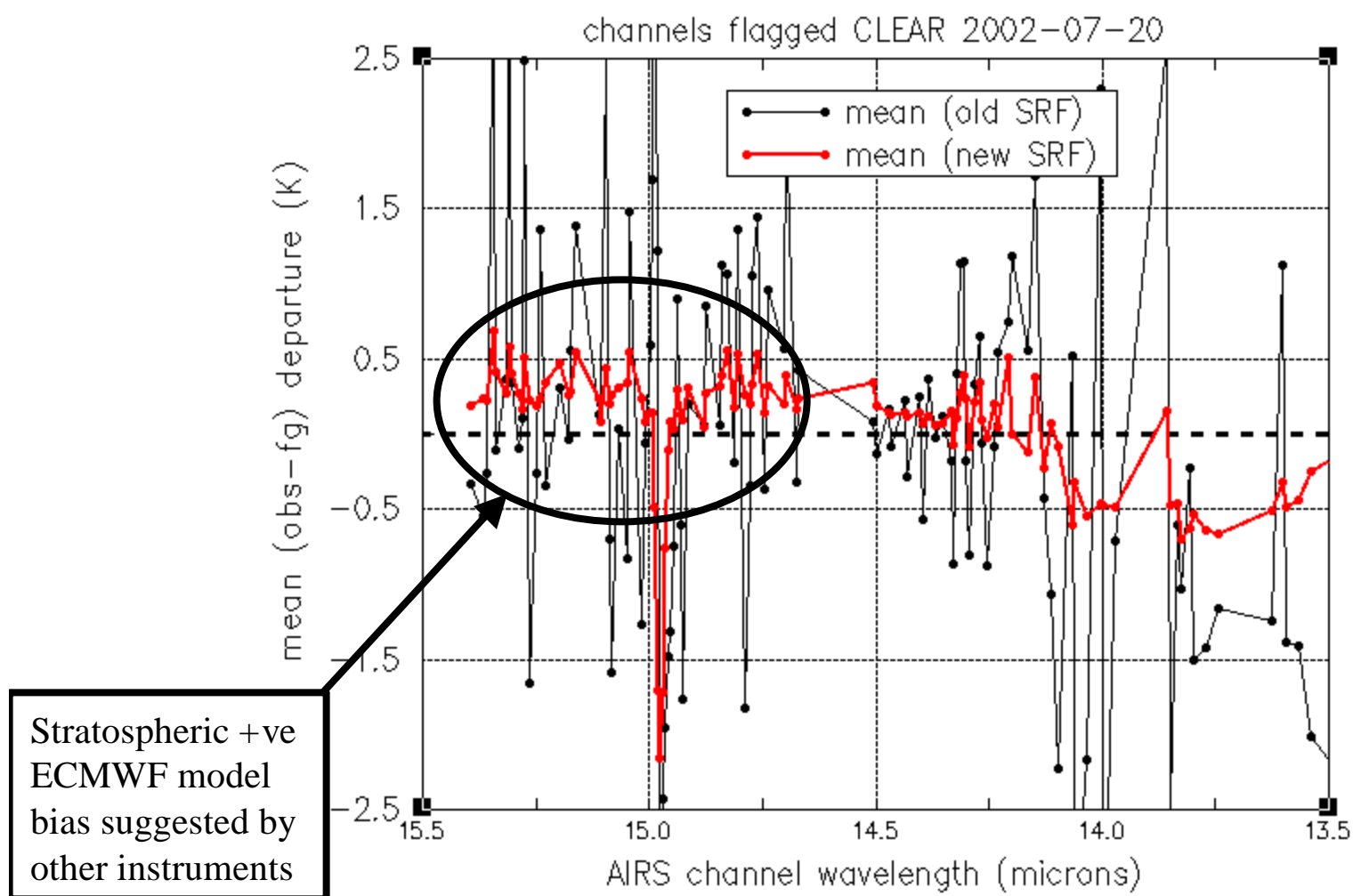
The statistics are:

(Observed AIRS radiance) minus (ECMWF-RT)

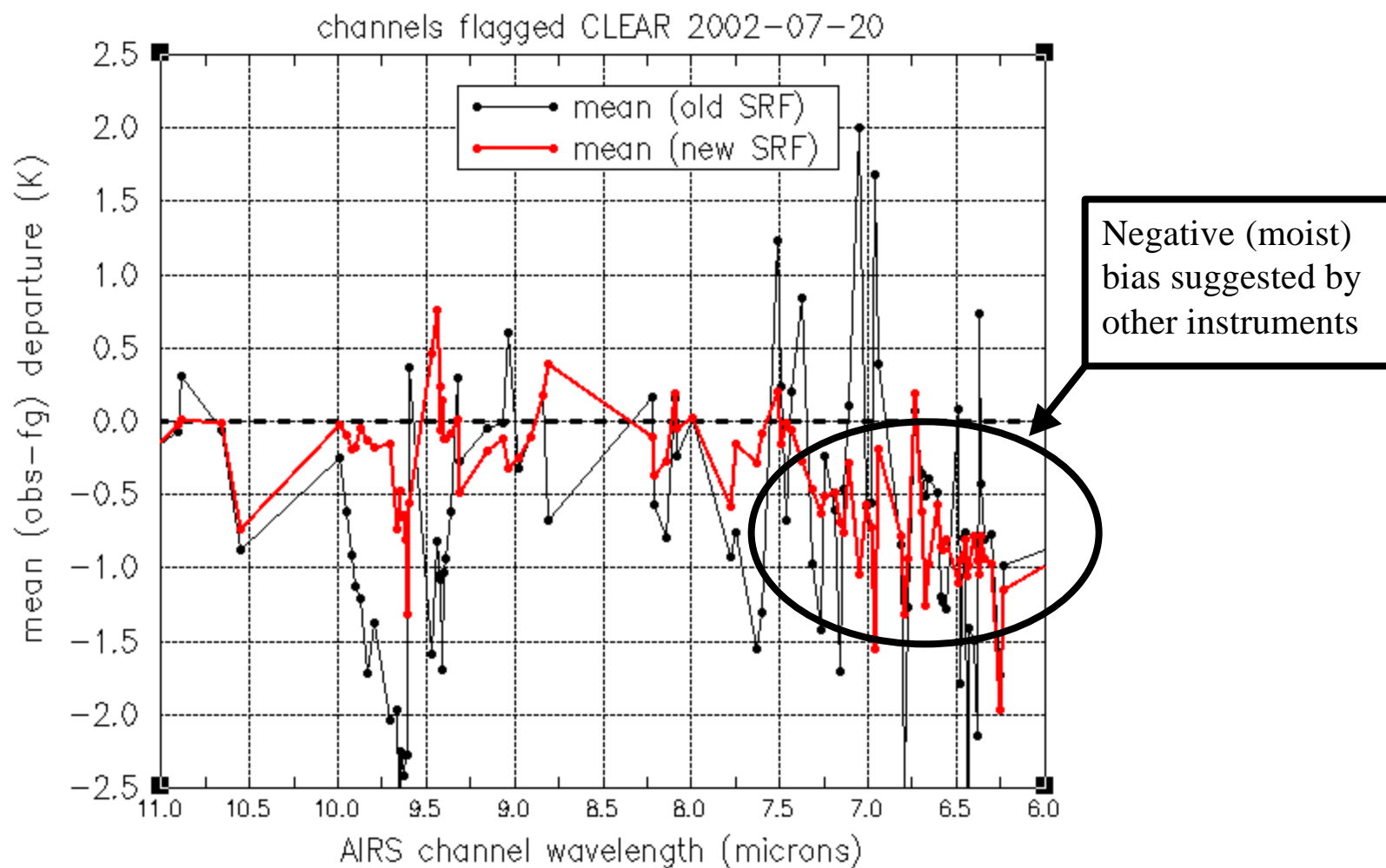
AIRS radiance departures from ECMWF model



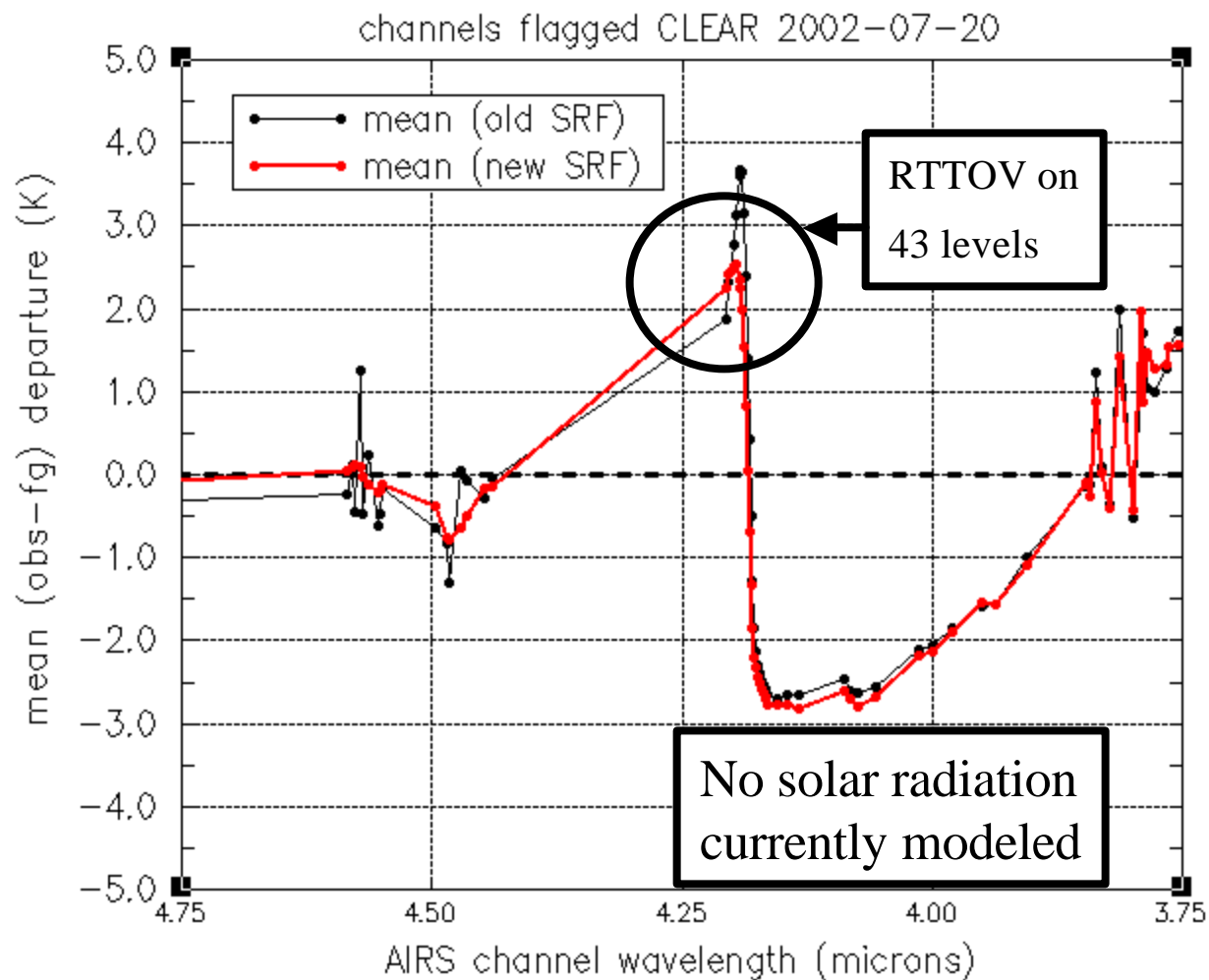
AIRS radiance departures from ECMWF model



AIRS radiance departures from ECMWF model



AIRS radiance departures from ECMWF model



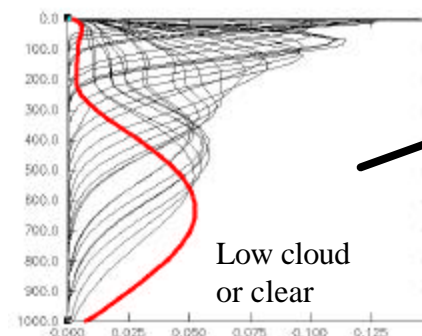
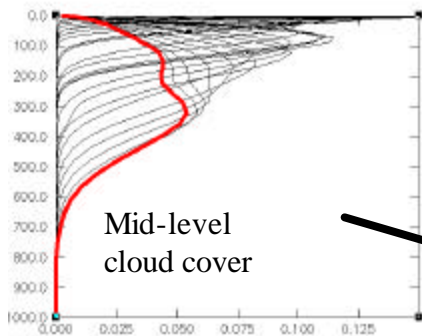
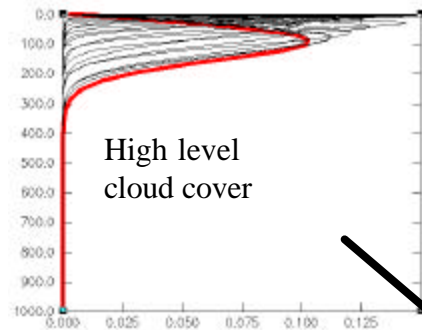
Preliminary assimilation of real AIRS radiances

Experimental details:

- Assimilation scheme : *3DVAR*
- Assimilation window : *6hrs*
- Model resolution : *TL159 (60 levels)*
- Data used : *All conventional + AIRS radiances*
- AIRS channel selection : *clear only from 281 NRT*
- Observation errors : *1.0K in each channel*

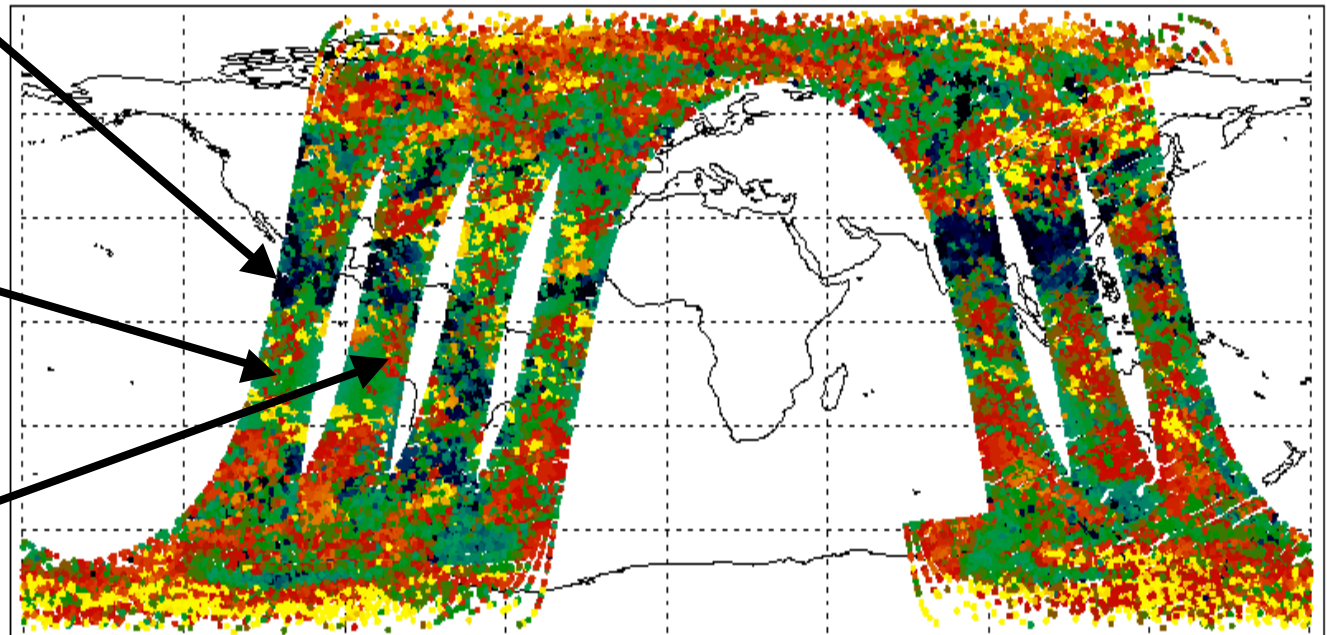
Channel use in 3DVAR assimilation based on clear flags

Temperature weighting functions



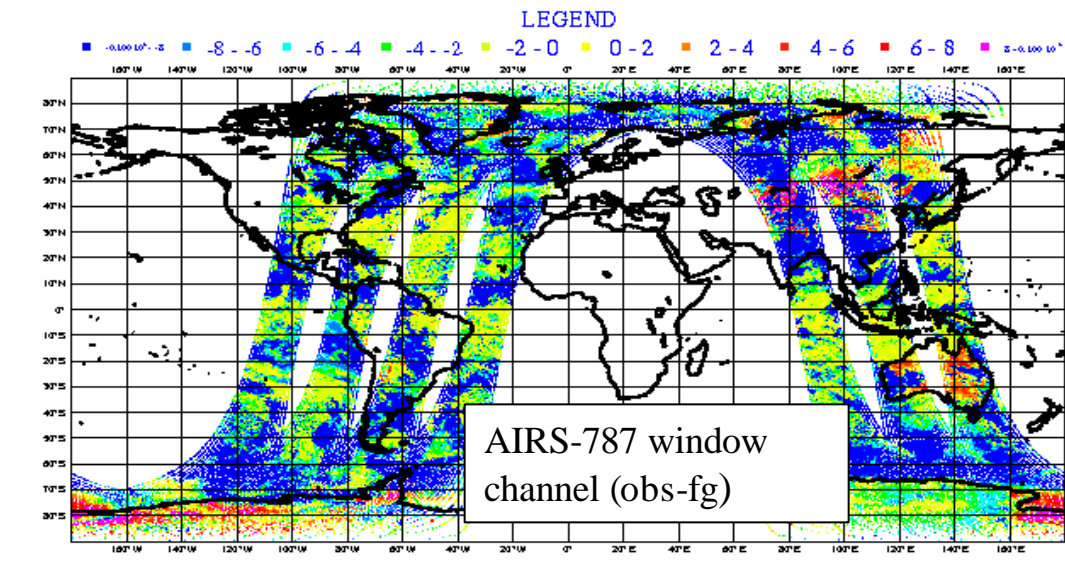
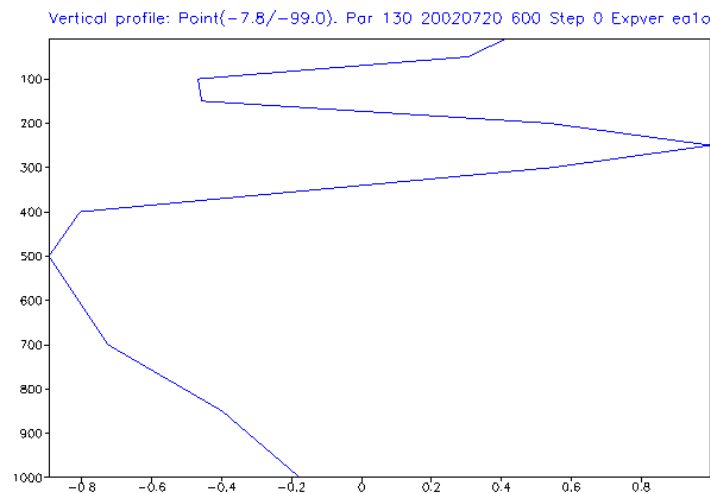
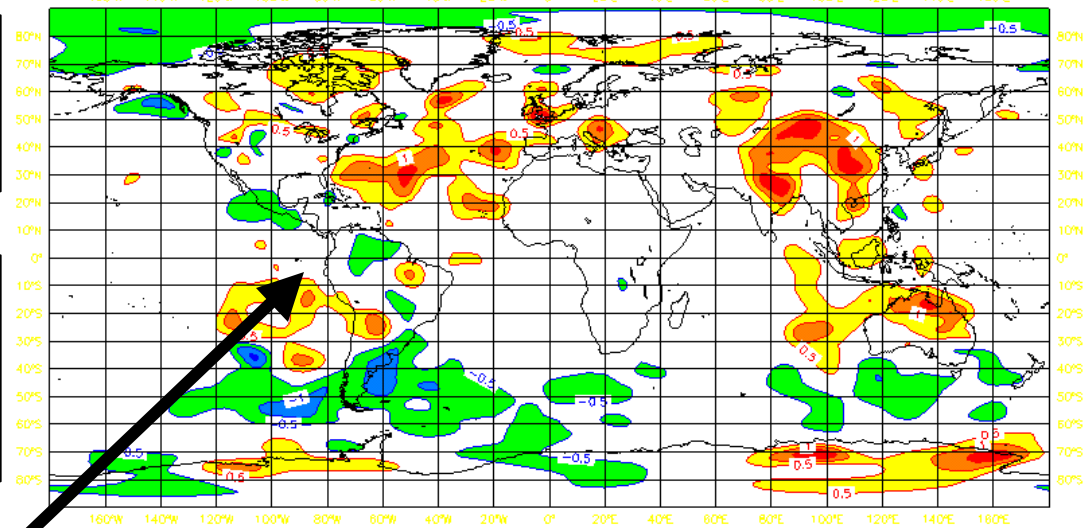
Tail pressure of lowest AIRS long-wave channel determined cloud-free (2002-07-20 real AIRS radiances)

30-155 155-280 280-405 405-530 530-655 655-780 780-905 905-+++



Temperature increments in (K) at
200hPa for 2002-07-20 for 06z (red
orange positive / green-blue negative)

ECMWF Analysis VT:Saturday 20 July 2002 06UTC 200hPa **temperature

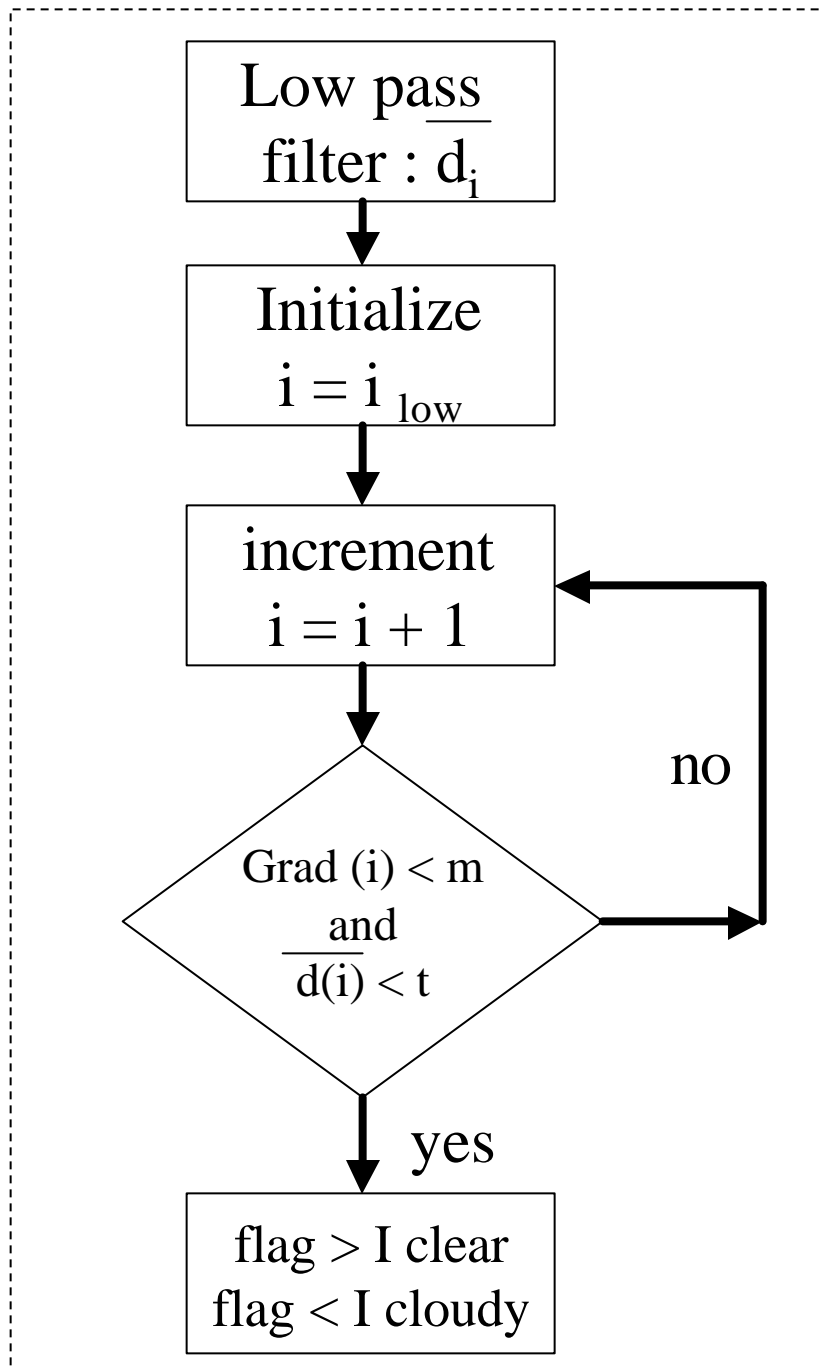


Summary of results for AIRS focus-day

- Cloud detection of clear AIRS channels working well but requires detailed validation with MODIS imagery
- Instrument radiance data generally simulated very well from NWP model using RTTOV radiative transfer (soon to be upgraded to 90 levels + new spectroscopy)
- Preliminary assimilation looks very encouraging, but sensible NWP impact trials pending NRT data flow and final SRFs.

Current schedule for AIRS assimilation at ECMWF

- Focus day (2002-07-20) data released by NASA in late August
- Analysis of focus day data (in progress)
- Initial re-tune of RT model (complete)
- NRT data activated by NESDIS ORA (October 2002)
- Activation of real-time monitoring results on ECMWF WWW
- Second (final ?) retune of RT model from NASA (end of 2002)
- Residual bias evaluation / correction
- NRT assimilation to evaluate NWP performance (spring 2003)
- Day-1 (conservative) Operational assimilation (late spring 2003)



Notes:

i_{low} is the channel ranked most sensitive to cloud

- the gradient is evaluated over (+1) and (+5) steps to avoid stopping as local max/min. The threshold is 0.001 ? The gradient is checked negative over cold surface and positive over warm surfaces.

- window channels are excluded that show surface (e.g. emissivity) features more than a monotonic cloud signal and cause dangerous termination when the clear-sky emission is poorly computed.

- the departure threshold is + / - 0.5K depending on surface type